

What Is Claimed Is:

1. A composition comprising a first oligomer and a second oligomer, wherein:
 - at least a portion of said first oligomer is capable of hybridizing with at least a portion of said second oligomer,
 - at least a portion of said first oligomer is complementary to and capable of hybridizing to a selected target nucleic acid, and
 - at least one of said first or second oligomers includes at least two nucleosides having a non-phosphorous-containing internucleoside linkage.
2. The composition of claim 1 wherein said first and said second oligomers are a complementary pair of siRNA oligomers.
3. The composition of claim 1 wherein said first and said second oligomers are an antisense/sense pair of oligomers.
4. The composition of claim 1 wherein each of said first and second oligomers has 12 to 50 nucleosidic bases.
5. The composition of claim 1 wherein each of said first and second oligomers has 15 to 30 nucleosidic bases.
6. The composition of claim 1 wherein each of said first and second oligomers has 21 to 24 nucleosidic bases.
7. The composition of claim 1 wherein said first oligomer is an antisense oligomer.
8. The composition of claim 7 wherein said second oligomer is a sense oligomer.
9. The composition of claim 7 wherein said second oligomer has a plurality of ribose nucleotide units.

10. The composition of claim 1 wherein said first oligomer includes said nucleosides having a non-phosphorous-containing internucleoside linkage.

11. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is an ether linkage of the formula -O-R₁-O- where R₁ is a group comprising a two or three carbon backbone.

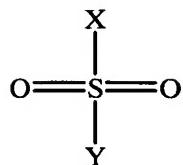
12. The composition of claim 11 wherein R₁ is an optionally substituted ethyl, ethylene, acetylene, cyclopropyl, cyclobutyl, ethylenoxy, ethylaziridine, aziridine, propyl, isopropyl, methyl-cyclopropyl, C3 through C6 carbocyclic, or 4-, 5-, or 6-membered nitrogen heterocyclic group.

13. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is an allyl ether linkage of the formula 2'/3'-O-CH₂CH=5' wherein a double bond is located between the 5' carbon atom and the adjacent substitute linkage atom.

14. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is an allyl sulfide linkage of the formula 2'/3'-S-CH₂-CH=5' wherein a double bond is located between the 5' carbon atom and the adjacent substitute linkage atom.

15. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a formacetal/ketal linkage of the formula -YC₂X₂Y- wherein each Y is independently O or S and each X is -H, -F, -Cl, -Br, -NO₂, -SCH₂CH₃, -COOH, -COOCH₃, -COOCH(CH₃)₂, -CONHCH₃, -CH₂F, -CF₃, -CH₂COOCH₃, -CH₂CONHCH₂CH₃, -CH₂CH₂COOH, -CH₂CH₂NH₂, -CH₂CH₂NHCH₂CH₃, or -CH₂CH₂CF₃.

16. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a sulfamate linkage of the formula:



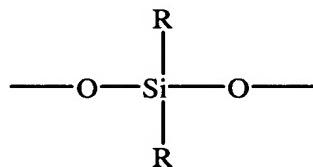
wherein X and Y are H or alkyl.

17. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a sulfonamide linkage of one of the following formulas:

3'- NHR₃-SO₂-CH₂-5' or 3'- NHR₃-SO₂-CH=5'

wherein R₃ is hydrogen, C1-5 alkyl optionally substituted by amino or hydroxy, piperidinyl, piperazinyl, morpholinyl, phenyl, benzyl, allyl, acetyl, or benzoyl.

18. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a siloxane linkage of the following formula:

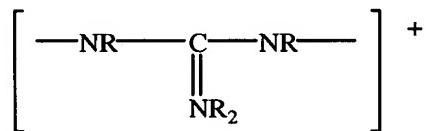


wherein each R is independently C1-C6 alkyl.

19. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is an amide or thioamide linkage of one of the following formulas: NR-C(O)-CH₂-CH₂, NR-C(S)-CH₂-CH₂, CH₂-NR-C(O)-CH₂, CH₂-NR-C(S)-CH₂, CH₂-CH₂-NR-C(O), CH₂-CH₂-NR-C(S), C(O)-NR-CH₂-CH₂, C(S)-NR-CH₂-CH₂, CH₂-C(O)-NR-CH₂, and CH₂-C(S)-NR-CH₂ where R is hydrogen, alkyl, substituted alkyl, aralkyl, alkenyl, alkaryl, aminoalkyl, hydroxyalkyl, heterocycloalkyl, heterocycloaralkyl, an RNA cleaving group, a group for improving the affinity for the RNA complement, or a group for improving the pharmacodynamic properties of the oligomer.

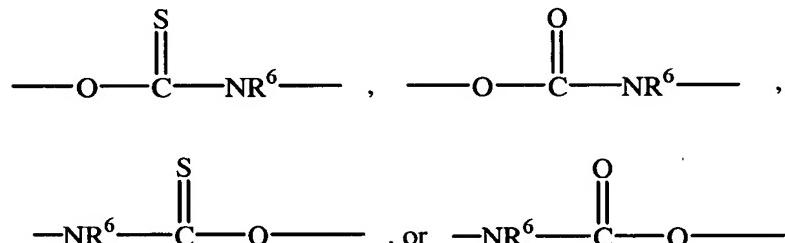
20. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a cationic alkylpolyamine linkage selected from the group consisting of a dimethylamino propylamine linkage, a N, N-diaminopropylamine linkage, and a diethyethylenediamine linkage.

21. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a guanidyl linkage of the following formula:



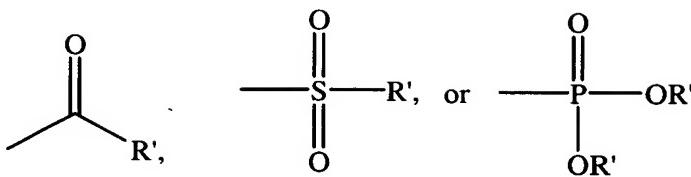
wherein R is a hydrogen atom, or a lower alkyl or phenyl group.

22. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas: -S-CH₂-CH₂-, -S-CH₂-, -O-CH₂-S-, -O-CH₂-O-, -CH₂-CH₂-S-, -CH₂-S-, -S-CH₂-O-,



wherein R⁶ is lower alkyl, OMe, OH, heteroalkyl, or aryl.

23. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas: -CH₂-CH₂-NR-, -NR-CH₂-CH₂-, -CH₂-NR-CH₂-, -CH₂CH₂-CH₂-O-, -CH₂-O-CH₂-, -S-CH₂-CH₂-, or -O-CH₂-CH₂-NR-, wherein R is hydrogen, lower alkyl, heteroalkyl, aryl, sulfonamide, phosphoramidate, NR', OR',



and R' is hydrogen, lower alkyl, heteroalkyl, or aryl.

24. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of the following formula:

-D-D-D-

where each D is independently CHR, oxygen or NR₆, wherein R is hydrogen, OH, SH or NH₂, R₆ is hydrogen or C₁-C₂ alkyl, and only one D is oxygen or NR₆.

25. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of the following formula:

-L₁-L₂-L₃-L₄-

wherein L₁ and L₄ are optionally substituted carbon atoms and L₂ and L₃ are, independently, optionally substituted carbon atoms, oxygen atoms, nitrogen atoms, phosphorus atoms, sulfur atoms, or silicon atoms.

26. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of the following formula:

L₁-L₂-L₃-L₄

wherein

L₁ and L₄ are, independently, CH₂, C=O, C=S, C-NH₂, C-NHR₃, C-OH, C-SH, C-O-R₁ or C-S-R₁;

L₂ and L₃ are, independently, CR₁R₂, C=CR₁R₂, C=NR₃, C=O, C=S, O, S, SO, SO₂, NR₃ or SiR₅R₆; or together form part of an alkene, alkyne, aromatic ring, carbocycle or heterocycle, and if L₁ is C=O or C=S then L₂ is not NR₃ or if L₄ is C=O or C=S then L₃ is not NR₃; or

L₁, L₂, L₃ and L₄ together comprise a -CH=N-NH-CH₂- or -CH₂-O-N=CH- moiety;

R₁ and R₂ are, independently, H; OH; SH; NH₂; C₁ to C₁₀ alkyl, substituted alkyl, alkenyl, alkaryl or aralkyl; alkoxy; thioalkoxy; alkylamino; aralkylamino; substituted alkylamino; heterocycloalkyl; heterocycloalkylamino; aminoalkylamino; polyalkylamino; halo; formyl; keto; benzoxy; carboxamido; thiocarboxamido; ester; thioester; carboxamidine; carbamyl; ureido; guanidino; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer;

R₃ is H, OH, NH₂, lower alkyl, substituted lower alkyl, alkoxy, lower alkenyl, aralkyl, alkylamino, aralkylamino, substituted alkylamino, heterocycloalkyl, heterocycloalkylamino, aminoalkylamino, polyalkylamino, a group for improving the pharmacokinetic properties of an oligomer or a group for improving the pharmacodynamic properties of an oligomer; and

R₅ and R₆ are, independently, C₁ to C₆ alkyl or alkoxy.

27. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas:

CH₂-R_A-NR-CH₂, CH₂-NR-R_A-CH₂, R_A-NR-CH₂-CH₂, CH₂-CH₂-NR-R_A, CH₂-CH₂-R_A-NR,
NR-R_A-CH₂-CH₂, or NR-R_A-CH₂

wherein

R_A is O or NR and R is H; alkyl or substituted alkyl having 1 to about 10 carbon atoms; alkenyl or substituted alkenyl having 2 to about 10 carbon atoms; alkynyl or substituted alkynyl having 2 to about 10 carbon atoms; alkaryl, substituted alkaryl, aralkyl, or substituted aralkyl having 7 to about 14 carbon atoms; alicyclic; heterocyclic; a reporter molecule; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer.

28. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas:

-CH₂-NR₁-NR₂-CH₂- or -NR₁-NR₂-CH₂-CH₂-

wherein

R₁ and R₂ are the same or different and are H; alkyl or substituted alkyl having 1 to about 10 carbon atoms; alkenyl or substituted alkenyl having 2 to about 10 carbon atoms; alkynyl or substituted alkynyl having 2 to about 10 carbon atoms; alkaryl, substituted alkaryl, aralkyl, or substituted aralkyl having 7 to about 14 carbon atoms; alicyclic; heterocyclic; a reporter

molecule; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer.

29. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of the following formula:

$L_1-L_2-L_3-L_4$

wherein

one of L_1 or L_2 is O or S, and the other of L_1 or L_2 is N-R, and combined L_3 and L_4 are CH₂, or L_3 is CH₂ and L_4 is CR'R";

one of L_3 or L_4 is O or S, and the other of L_3 or L_4 is N-R, and combined L_1 and L_2 are CH₂, or L_2 is CH₂ and L_1 is CR'R";

one of L_1 and L_4 is O, S or N-R, and the other of L_1 and L_4 is CR'R", and L_2 and L_3 are CH₂;

L_1 , L_2 , L_3 and L_4 together are O-N=CH-CH₂ or CH₂-CH=N-O;

L_1 is O, L_2 is N, L_3 is CH₂, and L_4 is C or CH, and together with at least two additional carbon or hetero atoms, L_2 , L_3 and L_4 form a 5 or 6 membered ring; or

L_1 is C or CH, L_2 is CH₂, L_3 is N, and L_4 is O, and together with at least two additional carbon or hetero atoms, L_1 , L_2 and L_3 form a 5 or 6 membered ring;

R is H; C₁ to C₁₀ straight or branched chain lower alkyl or substituted lower alkyl; C₂ to C₁₀ straight or branched chain lower alkenyl or substituted lower alkenyl; C₂ to C₁₀ straight or branched chain lower alkynyl or substituted lower alkynyl; a ¹⁴C containing lower alkyl, lower alkenyl or lower alkynyl; C₇ to C₁₄ substituted or unsubstituted alkaryl or aralkyl; a ¹⁴C containing C₇ to C₁₄ alkaryl or aralkyl; alicyclic; heterocyclic; a reporter molecule; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer; and

R' and R" are H; or R' is H and R" is O-R; or combined R' and R" are =O.

30. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas:

CR_{1a}R_{1b}-CR_{2a}R_{2b}-CR_{3a}R_{3b}-Z₄, CR_{1a}R_{1b}-CR_{2a}R_{2b}-Z₃-Z₄, CR_{1a}R_{1b}-Z₂-CR_{2a}R_{2b}-Z₄, Z₁-CR_{1a}R_{1b}-CR_{2a}R_{2b}-Z₄, CR_{1a}R_{1b}-Z₂-Z₃-Z₄, Z₁-CR_{2a}R_{2b}-Z₃-Z₄, or Z₁-Z₂-CR_{3a}R_{3b}-Z₄

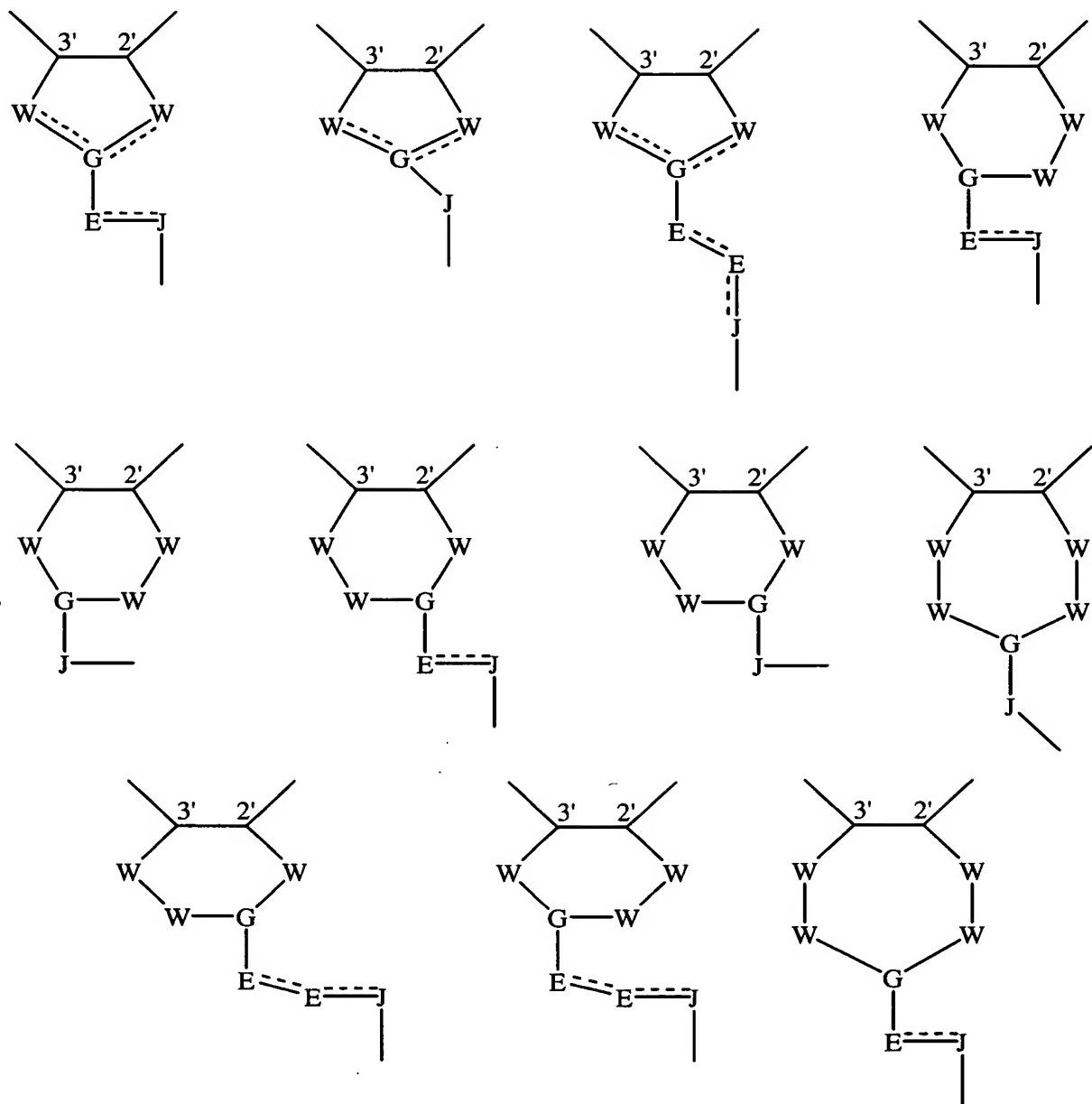
wherein

Z_1 , Z_2 , Z_3 and Z_4 are, independently, NR₄, S, SO, SO₂, Se, Si(R₆)₂, or O; R_{1a}, R_{1b}, R_{2a}, R_{2b}, R_{3a} and R_{3b} are, independently, H, R₅, O-R₅, S-R₅, NR₄R₅; or, independently, together R_{1a} and R_{1b}, or R_{2a} and R_{2b}, or R_{3a} and R_{3b} are =O;

R₄, R₅ and R₆ are, independently, H; C₁ to C₁₀ straight or branched chain lower alkyl or substituted lower alkyl; C₂ to C₁₀ straight or branched chain lower alkenyl or substituted lower alkenyl; C₂ to C₁₀ straight or branched chain lower alkynyl or substituted lower alkynyl; a ¹⁴C containing lower alkyl, lower alkenyl or lower alkynyl; C₇ to C₁₄ substituted or unsubstituted alkaryl or aralkyl; a ¹⁴C containing C₇ to C₁₄ alkaryl or aralkyl; C₆ to C₁₄ aryl; alicyclic; heterocyclic; a reporter molecule; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer; and

where said substituents are OH, =O, CO₂H, O-alkyl, SH, S-alkyl, NH-alkyl, N-(alkyl)₂, alkyl, F, Cl, Br, CN, CF₃, OCF₃, OCN, SOCH₃, SO₂CH₃, ONO₂, NO₂, N₃, NH₂, heterocycloalkyl, aryl, aralkyl, sulfide, silyl, intercalators, conjugates, imidazoles, amides, ester, ethers, carbonates, carbamates, ureas, polyamines, polyamides, polyethylene glycols or polyethers.

31. The composition of claim 1 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas:



wherein

each W is independently selected from the group consisting of O, S, SO, SO₂, CH₂, CH, CO, CF₂, CS, N, NH and NR₃, and adjacent W's are not -O-O-, -O-S-, -O-CF₂-, or -S-CF₂-;

R₃ is methyl, ethyl, propyl, isopropyl, butyl or isobutyl;

each E is independently selected from the group consisting of O, S, SO, SO₂, CH, CH₂, CO, CF₂, CS, N, NH, and NR₃, and adjacent E's are not -O-O-, -O-S-, -S-O-, -O-CF₂-, -CF₂-O-, -CF₂-S- or -S-CF₂-, and when E is CH or N, any adjacent E is CH or N or an adjacent J is CH and they are connected by a double bond;

J is selected from the group consisting of O, S, SO, SO₂, CH, CH₂, CO, CF₂ and CS, and adjacent -E-J-'s are not -O-O-, -O-S-, -S-O-, -CF₂-O-, -O-CF₂-, -CF₂-S- or -S-CF₂-, and when J is CH, any adjacent E is CH or N and they are connected by a double bond;

each G is independently selected from the group consisting of C, CH, N, CF, CCl, CBr, CI, and CR₄;

R₄ is C1 to C4 alkyl, fluoromethyl, difluoromethyl, trifluoromethyl, hexafluoroisopropyl, 5-tetrazole, hydroxymethyl, CH₂-(5-tetrazole), CN, CO₂H, CO₂R₃, CONH₂, CONHR₃, CON(R₃)₂, CH₂SR₃, CH₂SOR₃, CH₂SO₂R₃, CH₂CO₂H, CH₂CN, CH₂CO₂R₃, CH₂CONH₂, CH₂CONHR₃ or CH₂CON(R₃)₂.

32. A pharmaceutical composition comprising the composition of claim 1 and a pharmaceutically acceptable carrier.

33. A method of modulating the expression of a target nucleic acid in a cell comprising contacting said cell with a composition of claim 1.

34. A method of treating or preventing a disease or disorder associated with a target nucleic acid comprising administering to an animal having or predisposed to said disease or disorder a therapeutically effective amount of a composition of claim 1.

35. A composition comprising an oligomer complementary to and capable of hybridizing to a selected target nucleic acid and at least one protein, said protein comprising at least a portion of a RNA-induced silencing complex (RISC), wherein:

said oligomer includes at least two nucleosides having a non-phosphorous-containing internucleoside linkage.

36. The composition of claim 35 wherein said oligomer is an antisense oligomer.

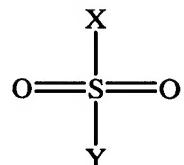
37. The composition of claim 35 wherein said oligomer has 12 to 50 nucleosic bases.

38. The composition of claim 35 wherein said oligomer has 15 to 30 nucleosidic bases.

39. The composition of claim 35 wherein said oligomer has 21 to 24 nucleosidic bases.
40. The composition of claim 35 further including a further oligomer, wherein said further oligomer is complementary to and hydrizable to said oligomer.
41. The composition of claim 40 wherein said further oligomer is a sense oligomer.
42. The composition of claim 40 wherein said further oligomer is an oligomer having a plurality of ribose nucleoside units.
43. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is an ether linkage of the formula -O-R₁-O- where R₁ is a group comprising a two or three carbon backbone.
44. The composition of claim 43 wherein R₁ is an optionally substituted ethyl, ethylene, acetylene, cyclopropyl, cyclobutyl, ethylenoxy, ethylaziridine, aziridine, propyl, isopropyl, methyl-cyclopropyl, C3 through C6 carbocyclic, or 4-, 5-, or 6-membered nitrogen heterocyclic group.
45. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is an allyl ether linkage of the formula 2'/3'-O-CH₂CH=5' wherein a double bond is located between the 5' carbon atom and the adjacent substitute linkage atom.
46. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is an allyl sulfide linkage of the formula 2'/3'-S-CH₂-CH=5' wherein a double bond is located between the 5' carbon atom and the adjacent substitute linkage atom.
47. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a formacetal/ketal linkage of the formula -YC₂X₂Y- wherein each Y is independently O or S and each X is -H, -F, -Cl, -Br, -NO₂, -SCH₂CH₃, -COOH, -COOCH₃, -COOCH(CH₃)₂, -CONHCH₃, -CH₂F, -CF₃, -CH₂COOCH₃, -CH₂CONHCH₂CH₃, -CH₂CH₂COOH, -CH₂CH₂NH₂,

-CH₂CH₂NHCH₂CH₃, or -CH₂CH₂CF₃.

48. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a sulfamate linkage of the formula:



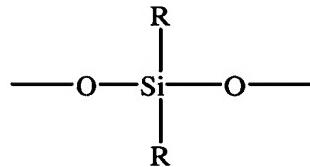
wherein X and Y are H or alkyl.

49. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a sulfonamide linkage of one of the following formulas:

3'-NHR₃-SO₂-CH₂-5' or 3'-NHR₃-SO₂-CH=5'

wherein R₃ is hydrogen, C1-5 alkyl optionally substituted by amino or hydroxy, piperidinyl, piperazinyl, morpholinyl, phenyl, benzyl, allyl, acetyl, or benzoyl.

50. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a siloxane linkage of the following formula:



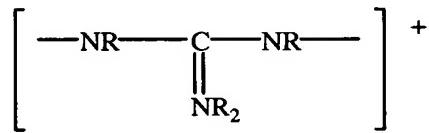
wherein each R is independently C1-C6 alkyl.

51. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is an amide linkage of one of the following formulas: NR-C(O)-CH₂-CH₂, NR-C(S)-CH₂-CH₂, CH₂-NR-C(O)-CH₂, CH₂-NR-C(S)-CH₂, CH₂-CH₂-NR-C(O), CH₂-CH₂-NR-C(S), C(O)-NR-CH₂-CH₂, C(S)-NR-CH₂CH₂, CH₂-C(O)-NR-CH₂, and CH₂-C(S)-NR-CH₂ where R is

hydrogen, alkyl, substituted alkyl, aralkyl, alkenyl, alkaryl, aminoalkyl, hydroxyalkyl, heterocycloalkyl, heterocycloaralkyl, a group for improving the affinity for the RNA complement, or a group for improving the pharmacodynamic properties of the oligomer.

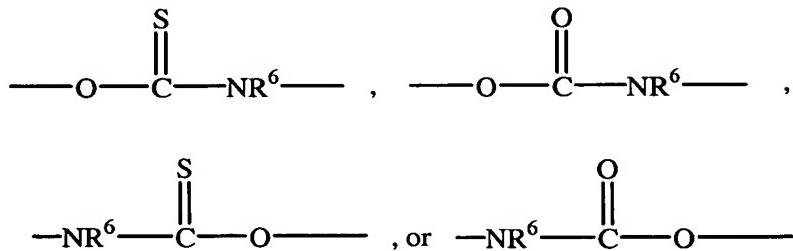
52. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a cationic alkylpolyamide linkage selected from the group consisting of a dimethylamino propylamine linkage, a N, N-diaminopropylamine linkage, and a diethyethylenediamine linkage.

53. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a guanidyl linkage of the following formula:



wherein R is a hydrogen atom, or a lower alkyl or phenyl group.

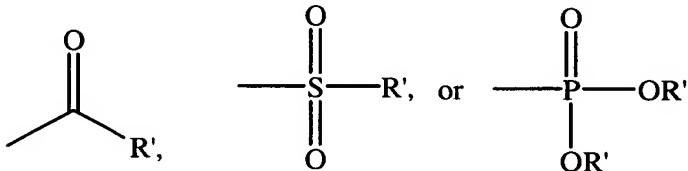
54. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas: -S-CH₂-CH₂-, -S-CH₂-, -O-CH₂-S-, -O-CH₂-O-, -CH₂-CH₂-S-, -CH₂-S-, -S-CH₂-O-,



wherein R⁶ is lower alkyl, OMe, OH, heteroalkyl, or aryl.

55. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas: -CH₂-CH₂-NR-, -NR-CH₂-CH₂-, -CH₂-

NR-CH₂-, -CH₂CH₂-CH₂-O-, -CH₂-O-CH₂-, -S-CH₂-CH₂-, or -O-CH₂-CH₂-NR-, wherein R is hydrogen, lower alkyl, heteroalkyl, aryl, sulfonamide, phosphoramidate, NR', OR',



and R' is hydrogen, lower alkyl, heteroalkyl, or aryl.

56. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of the following formula:

-D-D-D-

where each D is independently CHR, oxygen or NR₆, wherein R is hydrogen, OH, SH or NH₂, R₆ is hydrogen or C₁-C₂ alkyl, and only one D is oxygen or NR₆.

57. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of the following formula:

-L₁-L₂-L₃-L₄-

wherein L₁ and L₄ are optionally substituted carbon atoms and L₂ and L₃ are, independently, optionally substituted carbon atoms, oxygen atoms, nitrogen atoms, sulfur atoms, or silicon atoms.

58. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of the following formula:

L₁-L₂-L₃-L₄

wherein

L₁ and L₄ are, independently, CH₂, C=O, C=S, C-NH₂, C-NHR₃, C-OH, C-SH, C-O-R₁ or C-S-R₁;

L₂ and L₃ are, independently, CR₁R₂, C=CR₁R₂, C=NR₃, C=O, C=S, O, S, SO, SO₂, NR₃ or SiR₅R₆; or together form part of an alkene, alkyne, aromatic ring, carbocycle or heterocycle, and if L₁ is C=O or C=S then L₂ is not NR₃ or if L₄ is C=O or C=S then L₃ is not NR₃; or

L_1 , L_2 , L_3 and L_4 together comprise a $-CH=N-NH-CH_2-$ or $-CH_2-O-N=CH-$ moiety;

R_1 and R_2 are, independently, H; OH; SH; NH₂; C₁ to C₁₀ alkyl, substituted alkyl, alkenyl, alkaryl or aralkyl; alkoxy; thioalkoxy; alkylamino; aralkylamino; substituted alkylamino; heterocycloalkyl; heterocycloalkylamino; aminoalkylamino; polyalkylamino; halo; formyl; keto; benzoxy; carboxamido; thiocarboxamido; ester; thioester; carboxamidine; carbamyl; ureido; guanidino; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer;

R_3 is H, OH, NH₂, lower alkyl, substituted lower alkyl, alkoxy, lower alkenyl, aralkyl, alkylamino, aralkylamino, substituted alkylamino, heterocycloalkyl, heterocycloalkylamino, aminoalkylamino, polyalkylamino, a group for improving the pharmacokinetic properties of an oligomer or a group for improving the pharmacodynamic properties of an oligomer; and

R_5 and R_6 are, independently, C₁ to C₆ alkyl or alkoxy.

59. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas:

$CH_2-R_A-NR-CH_2$, $CH_2-NR-R_A-CH_2$, $R_A-NR-CH_2-CH_2$, $CH_2-CH_2-NR-R_A$, $CH_2-CH_2-R_A-NR$, $NR-R_A-CH_2-CH_2$, or $NR-R_A-CH_2$

where

R_A is O or NR and R is H; alkyl or substituted alkyl having 1 to about 10 carbon atoms; alkenyl or substituted alkenyl having 2 to about 10 carbon atoms; alkynyl or substituted alkynyl having 2 to about 10 carbon atoms; alkaryl, substituted alkaryl, aralkyl, or substituted aralkyl having 7 to about 14 carbon atoms; alicyclic; heterocyclic; a reporter molecule; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer.

60. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas:

$-CH_2-NR_1-NR_2-CH_2-$ or $-NR_1-NR_2-CH_2-CH_2-$

wherein

R_1 and R_2 are the same or different and are H; alkyl or substituted alkyl having 1 to about 10 carbon atoms; alkenyl or substituted alkenyl having 2 to about 10 carbon atoms; alkynyl or substituted alkynyl having 2 to about 10 carbon atoms; alkaryl, substituted alkaryl, aralkyl, or

substituted aralkyl having 7 to about 14 carbon atoms; alicyclic; heterocyclic; a reporter molecule; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer.

61. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of the following formula:

$L_1-L_2-L_3-L_4$

wherein

one of L_1 or L_2 is O or S, and the other of L_1 or L_2 is N-R, and combined L_3 and L_4 are CH₂, or L_3 is CH₂ and L_4 is CR'R";

one of L_3 or L_4 is O or S, and the other of L_3 or L_4 is N-R, and combined L_1 and L_2 are CH₂, or L_2 is CH₂ and L_1 is CR'R";

one of L_1 and L_4 is O, S or N-R, and the other of L_1 and L_4 is CR'R", and L_2 and L_3 are CH₂;

L_1, L_2, L_3 and L_4 together are O-N=CH-CH₂ or CH₂-CH=N-O;

L_1 is O, L_2 is N, L_3 is CH₂, and L_4 is C or CH, and together with at least two additional carbon or hetero atoms, L_2 , L_3 and L_4 form a 5 or 6 membered ring; or

L_1 is C or CH, L_2 is CH₂, L_3 is N, and L_4 is O, and together with at least two additional carbon or hetero atoms, L_1 , L_2 and L_3 form a 5 or 6 membered ring;

R is H; C₁ to C₁₀ straight or branched chain lower alkyl or substituted lower alkyl; C₂ to C₁₀ straight or branched chain lower alkenyl or substituted lower alkenyl; C₂ to C₁₀ straight or branched chain lower alkynyl or substituted lower alkynyl; a ¹⁴C containing lower alkyl, lower alkenyl or lower alkynyl; C₇ to C₁₄ substituted or unsubstituted alkaryl or aralkyl; a ¹⁴C containing C₇ to C₁₄ alkaryl or aralkyl; alicyclic; heterocyclic; a reporter molecule; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer; and

R' and R" are H; or R' is H and R" is O-R; or combined R' and R" are =O.

62. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas:

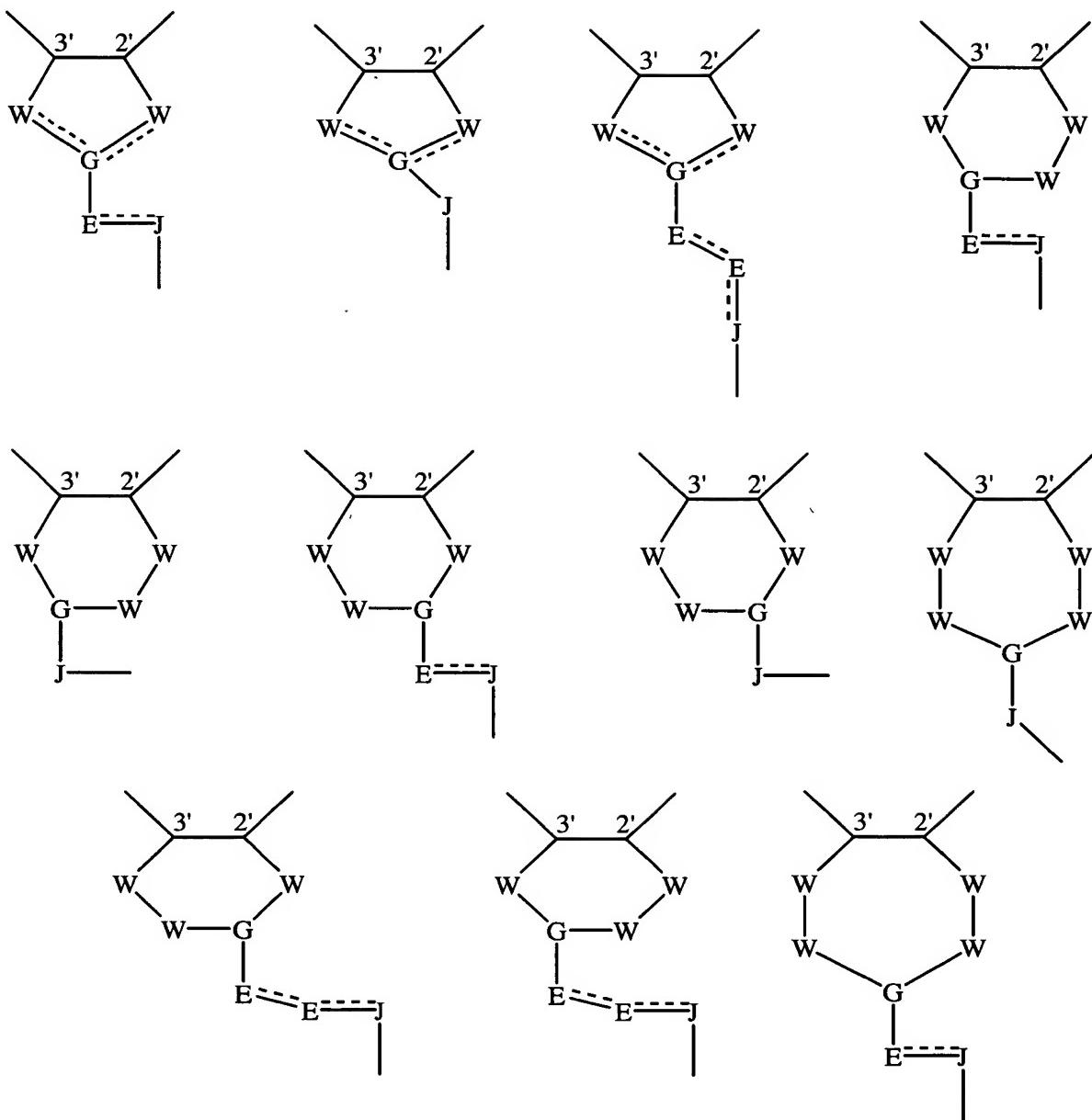
$CR_{1a}R_{1b}-CR_{2a}R_{2b}-CR_{3a}R_{3b}-Z_4$, $CR_{1a}R_{1b}-CR_{2a}R_{2b}-Z_3-Z_4$, $CR_{1a}R_{1b}-Z_2-CR_{2a}R_{2b}-Z_4$, $Z_1-CR_{1a}R_{1b}-CR_{2a}R_{2b}-Z_4$, $CR_{1a}R_{1b}-Z_2-Z_3-Z_4$, $Z_1-CR_{2a}R_{2b}-Z_3-Z_4$, or $Z_1-Z_2-CR_{3a}R_{3b}-Z_4$ wherein

Z_1 , Z_2 , Z_3 and Z_4 are, independently, NR_4 , S, SO , SO_2 , Se, $Si(R_6)_2$, or O;
 R_{1a} , R_{1b} , R_{2a} , R_{2b} , R_{3a} and R_{3b} are, independently, H, R_5 , $O-R_5$, $S-R_5$, NR_4R_5 ; or,
independently, together R_{1a} and R_{1b} , or R_{2a} and R_{2b} , or R_{3a} and R_{3b} are =O;

R_4 , R_5 and R_6 are, independently, H; C₁ to C₁₀ straight or branched chain lower alkyl or substituted lower alkyl; C₂ to C₁₀ straight or branched chain lower alkenyl or substituted lower alkenyl; C₂ to C₁₀ straight or branched chain lower alkynyl or substituted lower alkynyl; a ¹⁴C containing lower alkyl, lower alkenyl or lower alkynyl; C₇ to C₁₄ substituted or unsubstituted alkaryl or aralkyl; a ¹⁴C containing C₇ to C₁₄ alkaryl or aralkyl; C₆ to C₁₄ aryl; alicyclic; heterocyclic; a reporter molecule; a group for improving the pharmacokinetic properties of an oligomer; or a group for improving the pharmacodynamic properties of an oligomer; and

where said substituents are OH, =O, CO₂ H, O-alkyl, SH, S-alkyl, NH-alkyl, N-(alkyl)₂, alkyl, F, Cl, Br, CN, CF₃, OCF₃, OCN, SOCH₃, SO₂CH₃, ONO₂, NO₂, N₃, NH₂, heterocycloalkyl, aryl, aralkyl, sulfide, silyl, intercalators, conjugates, imidazoles, amides, ester, ethers, carbonates, carbamates, ureas, polyamines, polyamides, polyethylene glycols or polyethers.

63. The composition of claim 35 wherein said non-phosphorous-containing internucleoside linkage is a linkage of one of the following formulas:



wherein

each W is independently selected from the group consisting of O, S, SO, SO₂, CH₂, CH, CO, CF₂, CS, N, NH and NR₃, and adjacent W's are not -O-O-, -O-S-, -O-CF₂-, or -S-CF₂-;

R₃ is methyl, ethyl, propyl, isopropyl, butyl or isobutyl;

each E is independently selected from the group consisting of O, S, SO, SO₂, CH, CH₂, CO, CF₂, CS, N, NH, and NR₃, and adjacent E's are not -O-O-, -O-S-, -S-O-, -O-CF₂-, -CF₂-O-, -CF₂-S- or -S-CF₂-, and when E is CH or N, any adjacent E is CH or N or an adjacent J is CH and they are connected by a double bond;

J is selected from the group consisting of O, S, SO, SO₂, CH, CH₂, CO, CF₂ and CS, and adjacent -E-J-'s are not -O-O-, -O-S-, -S-O-, -CF₂-O-, -O-CF₂-, -CF₂-S- or -S-CF₂-, and when J is CH, any adjacent E is CH or N and they are connected by a double bond;

each G is independently selected from the group consisting of C, CH, N, CF, CCl, CBr, Cl, and CR₄;

R₄ is C1 to C4 alkyl, fluoromethyl, difluoromethyl, trifluoromethyl, hexafluoroisopropyl, 5-tetrazole, hydroxymethyl, CH₂-(5-tetrazole), CN, CO₂H, CO₂R₃, CONH₂, CONHR₃, CON(R₃)₂, CH₂SR₃, CH₂SOR₃, CH₂SO₂R₃, CH₂CO₂H, CH₂CN, CH₂CO₂R₃, CH₂CONH₂, CH₂CONHR₃ or CH₂CON(R₃)₂.

64. A pharmaceutical composition comprising the composition of claim 35 and a pharmaceutically acceptable carrier.

65. A method of modulating the expression of a target nucleic acid in a cell comprising contacting said cell with a composition of claim 35.

66. A method of treating or preventing a disease or disorder associated with a target nucleic acid comprising administering to an animal having or predisposed to said disease or disorder a therapeutically effective amount of a composition of claim 35.

67. An oligomer having at least a first region and a second region wherein:

 said first region of said oligomer is complementary to and capable of hybridizing with said second region of said oligomer,

 at least a portion of said oligomer is complementary to and capable of hybridizing to a selected target nucleic acid, and

 said oligomer includes at least two nucleosides having a non-phosphorous-containing internucleoside linkage.

68. The oligomer of claim 67 wherein each of said first and said second regions is at least 10 nucleosidic bases.

69. The oligomer of claim 67 wherein said first region in a 5' to 3' direction is complementary to said second region in a 3' to 5' direction.

70. The oligomer of claim 67 wherein said oligomer includes a hairpin structure.

71. The oligomer of claim 67 wherein said first region of said oligomer is spaced from said second region of said oligomer by a third region and where said third region comprises at least two nucleosidic bases.

72. The oligomer of claim 67 wherein said first region of said oligomer is spaced from said second region of said oligomer by a third region and where said third region comprises a non-nucleosidic base region.

73. A pharmaceutical composition comprising the composition of claim 67 and a pharmaceutically acceptable carrier.

74. A method of modulating the expression of a target nucleic acid in a cell comprising contacting said cell with a composition of claim 67.

75. A method of treating or preventing a disease or disorder associated with a target nucleic acid comprising administering to an animal having or predisposed to said disease or disorder a therapeutically effective amount of a composition of claim 67.